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UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF AGRICULTURAL ECONOMICS

Operations Guidance Report on

WATER FACILITIES FOR
POPO AGIE DRAINAGE BASIN
FREMONT COUNTY, WYOMING

Prepared by

WATER UTILIZATION SECTION
DIVISION OF LAND ECONOMICS

August 1939

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Under the Provisions of the
Water Facilities Act
(Public Law No. 399, 75th Congress)

August 1939

ACKNOWLEDGMENTS

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AUTHORIZATION

This report is made under the authority of the Water Facilities Act (Public Law No. 399, 75th Congress) approved August 28, 1937, and the Secretary of Agriculture's Memorandum of July 1, 1938, on Administration of the Water Facilities Program. The area covered by this report was authorized by the Water Facilities Board on April 27, 1939 at Washington, D. C., for planning and operations, in Wyoming State Memorandum No. 3, dated May 2, 1939.

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POPO AGIE DRAINAGE BASIN

WYOMING

SUMMARY AND RECOMMENDATIONS

The Popo Agie Drainage Basin is primarily adapted to livestock production and dairying. The average annual precipitation is sufficient in the area to produce good crop yields and supply sufficient run-off for storage. However, the uncertainty of yearly precipitation and its unfavorable seasonal distribution requires the storage of water to insure an adequate water supply for late season irrigation which is essential in securing average annual production of crops.

First class soils predominate throughout the irrigated sections of the area and produce good yields under good management. The [illegible] type soils become alkaline and seepy if not handled properly. Excessive application of irrigation water to the land has resulted in accelerated erosion and in loss of plant food materials by solution and their removal by leaching.

Domestic and stock water is obtained at relatively shallow depths from river alluvium. The use of ground water for irrigation does not appear necessary in this area. However, such water probably is recoverable from artesian aquifers.

There are three storage reservoirs which now supply a small amount of supplemental water. However, additional storage waters will provide a more stable system of agriculture for the area and insure a more efficient utilization of the land. With additional water and a more intelligent seasonal application of water, increases of 5 to 15 bushels in grain yields and ½ to 1 ton in alfalfa yields should result.

There is sufficient run-off during the spring months to satisfy all irrigation demands and supply water for storage in the three reservoirs. Such water is to be used during periods of inadequate stream flow. All water rights have been adjudicated or are operating under permits from the State Engineer. The Enterprise Public Irrigation District has been organized for use of the water stored in Frye Lake, and the North Fork of Popo Agie Public Irrigation District for use of the water stored in Shoshone Lake. No public irrigation district has been organized for use of water which might be stored in Christina Lake.

Final surveys will be necessary to determine accurately the capacities at the various sites which will provide the most advantageous and economical storage.

On the basis of the available information, the following recommendations are made:

1. The three above-mentioned reservoirs be enlarged to alleviate the shortage of irrigation water in all of the irrigated sections of the area.

2. [illegible] all features commensurate with sound engineering practices, natural limitations, and the public good. All the irrigated lands which are in need of supplemental water are not embraced in the Irrigation Districts, and, from available information, it appears desirable that sufficient storage be provided to supply lands both within and without the Districts. Operators within the Districts probably will not agree to obligating their districts for construction costs over and above those costs necessary for the irrigation demands of the lands within the District boundaries. Consideration should be given to determining ways and means for development of storage to utilize the available water supply to the best advantage of lands both within and without the Districts.

3. Stream gaging stations be established and water measuring devices be installed to aid in the distribution of water in the area.

I

PURPOSE AND SCOPE

This report presents the physical and economic characteristics of the Popo Agie Drainage Basin as a guide for immediate operations in the development of water facilities in the Basin.

Available information as presented in this report indicates the desirability of immediate development of additional surface water supply for land now irrigated in the area. It is, therefore, believed that the recommendations made herein should result in a more efficient utilization of water and land resources in the area and thereby tend to stabilize the agriculture of the area.

II

DESCRIPTION OF THE AREA

Location and Size

The Popo Agie River Drainage Basin lies in west central Wyoming, in the southwestern part of Fremont County. It is bounded on the north by the Little Wind River drainage, on the east by the Beaver Creek drainage, on the south by the Sweetwater and Twin Creek drainages, and on the west by the Continental Divide. The area comprises approximately 814 square miles. The elevation varies from about 11,000 feet at the Continental Divide to approximately 5,000 feet at Hudson, Wyoming.

Topography and Drainage

The area is drained by three principal tributary streams which make up the main Popo Agie River. The North Fork, which receives most of its water from numerous small lakes, rises in the mountains in the northwestern part of the area. It flows in a general easterly direction along the northern edge of the area to a point about two miles northeast of Lander where it joins the Middle Popo Agie. The Middle Fork of the Popo Agie rises in the mountains of the southwestern part of the area and flows east for

about 15 miles, thence northeast to its confluence with the North Fork. There are two small drainages lying between North and Middle Forks. These are drained by Baldwin and Squaw Creeks. They are comparatively small streams, being only about 14 miles in length. They flow in a general northeasterly direction to their confluence with Middle Fork about 1-3/4 miles northeast of Lander. The Little Popo Agie, with its tributaries, drains the south central and eastern parts of the area and has its source in a chain of mountain lakes in the south central part of the area. It flows in a northeasterly direction to a point about 10 miles southeast of Lander, thence north to its confluence with the Popo Agie at Hudson, Wyoming. In the higher reaches, these are typical mountain streams. As they reach the rolling agricultural lands of the area, they become broader and meander through the valley floors.

Most of the agricultural lands adapted to irrigation lie in long, comparatively narrow valleys. These valleys vary from about 3/4 mile to two miles in width. They are separated by ridges which are not adapted to irrigation farming.

The topography varies greatly over the area due largely to the variety of geologic formations outcropping as folds and ridges paralleling the Wind River Mountain Range.

[illegible]

There are three Weather Bureau stations located in the area. The station at Lander, elevation 5,372 feet, is maintained by the Weather Bureau and compiles complete climatological data, while the one at Middle Fork, elevation 6,700 feet, is a cooperative station maintained by the Forest Service. A few years of record are available for Arapahoe, elevation 5,000 feet.

The average annual precipitation for the 46 years of record at Lander, Wyoming, is 13.63 inches.[1] During this period, there were 22 years above the average and 24 years below. The lowest yearly precipitation recorded was 7.25 inches in 1902, the highest of record was 21.56 inches in 1923. The months of highest precipitation are April and May, during which the two-month average is 4.67 inches, or 34 per cent of the average yearly total occurs. The combined average precipitation during March, April, and May amounts to [illegible] per cent of the average yearly total. During June, July, and August, 2.60 inches, or 19 per cent of the average annual precipitation, occurs. The weather station at Lander, Wyoming, shows only 12 excessive rains during its period of record.

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[1] Weather data obtained from U. S. Weather Bureau Station records, Lander, Wyoming, 1892-1937 inclusive.

The average seasonal snowfall at Lander, Wyoming, for the months of September through June is 68.4 inches. March and April are the months of greatest snowfall, during which time 38 per cent of the seasonal total is received.

The average annual precipitation for the 21 years of record, 1917-1938, at the Middle Fork Ranger Station is 18.53 inches[1], while at Arapahoe, for an incomplete record for 11 years (1908 to 1918), it is 9.58 inches.[1]

There are no weather records for the higher elevations of the area. The south and west rim of the basin is approximately 6,000 feet higher than Lander, and 5,000 feet higher than North Fork Ranger Station. That there is much greater precipitation at the higher elevations is indicated by precipitation records and measurement of snow courses on Roaring Fork (elevation 10,300 feet) which shows the average annual depth of snow in April as about 54 inches, for the period 1932 to 1939 inclusive. On Roaring Fork and Townsend Creek (elevation 8,100 feet), the average depth of snow for the same period was 22 inches.

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[1] Climatic Summary of the United States, Section 13, Northeastern Wyoming.

The water content of the snow on Roaring Fork, on February 28, 1939, was 22 per cent. On April 1, 1939, the water content was 29 per cent. Although it is shown that the yearly snowfall at Lander is greater than the measurements shown for the snow courses during the month of April, the snow course measurements represent the depth of snow actually on the ground in April after settlement.

Temperature

The average annual temperature for the 46 years of record at Lander is 42.8°. The average monthly minimum is 18.8° in January, and the average monthly maximum of 68.1° occurs in July. The highest temperature of record was 102° in July 1935. The lowest recorded temperature was -40°, which occurred in December 1924.

Growing Season

The average growing season for the 46 years of record was 123 days. The longest season, 177 days, occurred in 1900; the shortest, 70 days, occurred in 1899. The latest killing frost in the spring occurred June 20, 1929; and the earliest in the fall occurred August 23, 1899.

Wind

The prevailing direction of the wind is southwest. The average hourly velocity is [illegible] miles per hour.

Cultural Features

Lander, a town of approximately 2,000 population, is the only town of size lying within the area. It has adequate schools, a hospital, and all other facilities necessary to meet the demands of the entire area. A flour mill is also located at Lander. Hudson, a small town, lies in the northeast corner of the area. At one time coal mines and a small oil development in the vicinity of Hudson were a good source of employment, but these have almost suspended operations. A few of the mines operate, but only to supply local needs. Casper and Rawlins are the two largest towns near the area. Casper lies about 150 miles to the east and Rawlins about 150 miles to the southeast.

The area is adequately supplied with roads, there being two oiled highways and several good county roads. A branch line of the Northwestern Railroad has its railhead at Lander. In view of these transportation facilities and the fact that Casper and Rawlins are on main highways and main line railroads, the shipping and transportation of livestock and crops raised in the area should present no serious problem.

There are three utilities serving the town, namely, Mountain States Telephone Company, Mountain States Power Company, and the Northern Utilities Company.

Soils[1]

The following is a brief description of the soils series which are to be found in this area:

The Wind River Series occurs on level bench and terrace areas, and has a sandy gravelly substratum at 30 to 36 inches, which insures good drainage on the sandier types. The heavier types become alkaline and seepy if not handled properly. Crop yields vary with the character of the farming. On the shallower profiles much water may be lost through the gravel horizon if water runs are too long. The sandier types are well adapted to alfalfa and grain crops.

The Ethete Series[2] are found on the lower, level, irrigated bench and terrace lands where the gravel is more or less diffused throughout the profile instead of occurring in a definite layer as in the Wind River Series. The sandier types are considered good, quickly irrigated soils because of their friable, open texture. Sandier types are well drained. The heavier types, however, are difficult to reclaim when impregnated with alkali. Productivity is a reflection of farm management.

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[1] Adapted from T. J. Dunnewald's "Quality of Soil, Lander-Wind River Project, Fremont County, Wyoming, 1934" and a Reconnaissance Survey by S. C. S. at Lander, Wyoming, 1939.

[2] Field name not yet passed upon by the Bureau Correlation Committee.

The Arapahoe Series[1] are shallow soils derived from shales on rolling country. The lighter textured types are easily worked, but the heavier soils are hard to work and become readily impregnated with alkali. Due to the rolling topography and proximity to saline shales, these soils are best adapted to pasture where irrigation should be carefully practiced to prevent seep, alkali accumulation, and erosion.

The Saddle Series[1] are residual soils developed on sandstone on rolling uplands. The profile is the most mature and developed of any of the series found in the area. Good drainage and ease of cultivation are characteristic of these soils. Alfalfa and grain crops do well. The more sandy, shallower, and rolling types appear best adapted to pasturage as a means of erosion prevention.

The Chugwater Series[1] is easily recognized by its reddish color, developed on sandstones, limestones, and alluvial materials of similar nature. These soils are very fertile, but in most cases are difficult to water and cultivate. Erosion by wind and water is a serious factor in their use. Pasture and permanent cover crops are the crops best adapted to this series.

Laurel and Harlem Soils include the first bottom soils along the streams where high water stages of the stream cause flooding and deposition of variable alluvial materials. Brushy sloughs, channels,

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[1] Field name not yet passed upon by the Bureau Correlation Committee.

and open grass meadows are interspersed with a rather dense growth of cottonwood trees. These areas should probably be confined to pasture. Cultivation is difficult, due to frequent inundation and alkali accumulation with irrigation of higher slopes.

Areas of *rough broken land* include rock ledges, outcrops, steep stony and gravelly slopes, and all other land too rough and stony for cultivation. There is very little soil cover on which forage can grow.

The characteristics of the soils determine to a large extent the degree of development of irrigation in the area. The following discussion of the relationship between soil characteristics and degree of development of irrigation in the area is based on the sections of the area covered by the three irrigation districts which are discussed in detail in the section of this report on existing water facilities. (See Map 2 in Appendix.)

The Little Popo Agie Irrigation District[1] because of its long, even gradient slopes, averaging 3 per cent, is almost entirely irrigated. The Enterprise Public Irrigation District lies in an area of rough to rolling topography, with slopes averaging 20 per cent.

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[1] Little Popo Agie Irrigation District is not a legally established Irrigation District. For the purpose of identification, it is referred to as Little Popo Agie Irrigation District in this report.

As a consequence, there are large areas of rough broken and rock outcrop land, knolls, and hills that lie above, or are inaccessible to, the ditch, and areas that are too steep to irrigate. The North Fork of Popo Agie Public Irrigation District is situated along the level flood plain and terrace areas of the North Fork of Popo Agie River, and is almost wholly irrigable.

Observations and opinions of farmers and water commissioners indicate that water is applied only to the best land. Probably 25 per cent more land could be irrigated, but, because of steep topography, rocks, and heavy soil, it is considered to be second class land. This type of land is to be found on almost every farm throughout the Enterprise and North Fork areas, whereas the Little Popo Agie Irrigation District is relatively free from second-class land. Due to lack of sufficient water and relatively poor prices for crops that second-class land could produce, these lands still remain in sagebrush, but are, in places, watered by waste water to provide better pasture.

There are small scattered portions throughout the areas of the three irrigation districts which, because of soil characteristics, do not irrigate well. However, in the aggregate, they do not constitute over 5 per cent of the irrigable area. Most of the land non-irrigable because of soil characteristics lies above the ditch.

There are numerous small, scattered alkali spots, from 1 to 40 acres in extent throughout all the irrigable area of the watershed.

These areas are too scattered and numerous to delineate seperately without a detailed survey. These spots aggregate approximately 10 per cent of the formerly irrigable area of the watershed and are of varied intensities of salinity. Most of the conspicuous areas are prohibitive to crops and in half of the cases are too saline to provide pasture.

Geology[1]

The irrigable land areas lie largely in strike valleys paralleling the Wind River Mountain chain, where rocks of the Mesozoic age are steeply inclined due to structural folding.

The North Fork Popo Agie Irrigation District lies in the superimposed stream valley of the North Fork of Popo Agie River. The valley traverses the shales, clays, sands, and sandstones of the Chugwater, Sundance, and Morrison formations of the Mesozoic age, and the Dakota, Mowry, and Frontier formations of the Cretaceous age.

The Enterprise Irrigation District lies in one of the numerous strike valleys paralleling the Wind River Mountain Range. The formations that outcrop within the area are mainly sandstones, with some limestone and shale in the Chugwater, Sundance, and Dakota formations, and largely shale, with some sandstone, in the Morrison formation.

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[1] See Map 1 in Appendix.

The Little Popo Agie Irrigation District lies in the valley of the Little Popo Agie River. Mesa Verde sandstone forms the outcrop scarp to the town of Hudson. At Hudson, the valley emerges into the valley of Big Popo Agie, which is cut through relatively horizontal Tertiary sandstones, shales, and clays. The upper Cretaceous formations underlie the upper portion of the valley, and were folded up with the upthrust of the Wind River Mountains, and, as a consequence, dip eastward beneath the area.

Ground Water

Domestic and stock water is readily obtainable at relatively shallow depths (10 to 30 feet) from river alluvium. The quantity of this water is generally sufficient, although on the margin of the alluvial valleys the amount of water may fluctuate with high water in the streams and irrigation ditches. The quality of the water is fair, although the shallower supplies, where they are located in depression areas or where they come in contact with seep water, have a tendency to be alkaline. Somewhat deeper wells (50 to 200 feet) secure water from the sandstone members which dip under the area. These wells generally supply an abundance of water of good quality. Artesian aquifers are reached at varying depths (100 to 500 feet), and supply abundant water of variable quality. Generally, the sandstone members of the Sundance and Dakota supply an adequate quantity

of potable water, whereas water secured from the shale members of the Chugwater, Mowry, and Morrison is generally of poor quality.

There is a possibility that sufficient and satisfactory water for irrigation purposes can be obtained from artesian aquifers. This water is recoverable from depths up to 1,000 feet, but, due to the complex faulting and folding in the area, it is not desirable to attempt to make prediction without detailed field investigations. The use of ground water for irrigation does not appear necessary in this area.

III

SURFACE WATER

Gaging Stations

There are few records of stream gagings available for this area. The only stations covering a considerable period of time (1906-1916) are located near Arapahoe. One of these stations is below the confluence of the Popo Agie River and the Little Wind River. The other is on the Little Wind River, a short distance above the point where it joins the Popo Agie River. Flow records for short periods are available for stations on the Little Popo Agie at Hudson, and on the Big or Middle Popo Agie near Lander.

Surface Water Supply

The drainage area covered by this report is 814 square miles, including the North Fork drainage of 191 square miles, the Big or Middle Fork drainage area of 277 square miles, and the Little Popo Agie drainage area of 346 square miles. In making computations for run-off determination, run-off figures for the stations near Arapahoe and near Lander, and at Hudson have been used. It is felt that the North Fork area and the Middle Fork area are sufficiently comparable in most factors, that each contributes to the

flow at the Arapahoe station very nearly in direct proportion to its area.

Available information and opinions of local residents indicate that there is a shortage of water during the latter part of the irrigation season. The present Water Commissioner has held that office for the last six years, and has found it necessary to regulate the use of water on some tributary ditches as early as June 1, but does not have to regulate the diversion of water from main streams until about the middle of July. Some years, during the late irrigation season, water was not available except for stock and garden needs.

Surface Water Available for Storage

Water available for storage has been estimated from records of the gaging station on the Big or Middle Popo Agie River above Lander, Wyoming. The only diversion for irrigation above this station is from Roaring Fork Creek to supply the Enterprise Ditch and for the present storage in Frye Lake Reservoir. The capacity of the supply ditch is 25.5 cubic feet per second.[1] The undepleted flow at the station was estimated.[2] From the undepleted flow the average seasonable run-off per square mile for the area above the

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[1] Records of State Engineer's office. Permit 4904 Enlargement, dated August 30, 1933, for reservoir inlet from Roaring Fork Creek.

[2] See Tabulation, Table 1.

gaging station was determined as 1,004 acre-feet for the period April to October inclusive.[1] The run-off per square mile from the area above the diversion from Roaring Fork is probably much greater than that for the entire area above the station at Lander, since more precipitation occurs at the higher elevations of Roaring Fork drainage, and the rough topography, lighter vegetative cover, and other factors are conducive to high yields. This computed run-off was used in estimating the water supply for Christina and Shoshone Reservoirs because the information available was the most reliable it was possible to obtain, and the three drainage areas are comparable.

Estimates of undepleted flows on other drainages in the area include a 30 per cent[2] addition to the adjudications and permits to allow for conveyance losses. No allowance was made for return flow because it is reflected in the amount of water passing the gaging station.

The daily record of measurements at the Hudson station, which is located below all diversions from the Little Popo Agie River, shows a minimum flow of 26 cubic feet per second for the year 1938. It appears that much of this water could have been used above the station for irrigation, although it is possible that part of this flow

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[1] This compares favorably with an 18-year record of 1,022 acre-feet per square mile, during the same months, for the drainage area above the gaging station on Bull Lake Creek, near Lenore, Wyoming, about 30 miles north and west of Lander. These drainage areas are comparable in most factors affecting run-off.

[2] Estimate given by Water Commissioner, and from past engineering experience.

is necessary to satisfy prior rights downstream. There is a surplus above all demands from the Big or Middle Popo Agie River during the months of April, May, and June when the Frye Lake Reservoir is being filled.

Records of discharge for 1953, at the gaging station on the Little Popo Agie River at Hudson show that there were available for storage 2,380 acre-feet during the period May 13 to June 30, as compared with 4,249 acre-feet for the average of the years of record. It is probable that the same condition prevailed for the water supply for storage in Frye Lake and Shoshone Lake.

For the purpose of determining the quantity of water available for storage in Frye Lake, Christina Lake, and Shoshone Lake Reservoirs, the best available information obtainable from records, opinions of local residents, and past experience have been used. In all instances, the adjudicated rights and permits have been used as the basis for computation of irrigation water demand.

As indicated in Table 1, the water available for storage in the Frye Lake, Christina Lake, and Shoshone Lake Reservoirs is 7,047; 4,249; and 7,790 acre-feet respectively.

While 7,047 acre-feet of water are available for storage in the Frye Lake Reservoir, its present capacity is only 870 acre-feet.[1] Christina Lake stores about 1,100 acre-feet[1] although 4,249 acre-feet

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[1] See section of report on existing water facilities.

of water are available for storage. Similarly, while 7,790 acre-feet of water are available for storage in the Shoshone Lake Reservoir, its present capacity is only about 950 acre-feet[1] of water.

A detailed survey of individual units should be made to determine actual irrigable and irrigated acreages, amount of diversions, losses, return flow, and other factors.

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[1] See section of report on existing water facilities.

Ta LDS,

Location	Period of Record	Dr ember	October	Total for Period Shown
1. Average monthly discharge of e with Little Wind River.[1]				
Sec. 23, T. 1 S., R. 3 E.	1906-1918 Intermittent 11 yr.	14,799 S	21,400	458,695
2. Average monthly discharge of ence with Popo Agie River.[1]				
Sec. 23, T. 1 S., R. 3 E.	1906-1918 Intermittent 11 yr.	8,622 S	7,852	179,536
3. Computed average monthly dis apahoe, Wyoming. (1 minus 2).				
Sec. 23, T. 1 S., R. 3 E.	1906-1918 Intermittent 11 yr.	3,177 S	13,548	279,159
4. Average monthly discharge of h Big Popo Agie River.[1]				
3/8 mi. S. W. of Hudson at Highway bridge	1907-1917 1938 Intermittent 8 yrs.	3,479 S	4,075	70,037
5. Average monthly discharge of h Big Popo Agie River.[1]				
3/8 mi. S. W. of Hudson at Highway bridge	1 year 1938	2,650 S		22,166

Table 4.—AVERAGE MONTHLY DISCHARGE, [illegible], [illegible] AND YIELDS,
ALL IN ACRE-FEET, AT STATIONS IN THE POPO AGIE [illegible] BASIN.

Location	Period of Record	Drainage Area	April	May	June	July	August	September	October	Total for Period Shown
1. Average monthly discharge of Popo Agie River at gaging station near Arapahoe, Wyoming, below confluence with Little Wind River.[1]										
Sec. 25, T. 1 S., R. 5 E.	1906-1918 Intermittent 11 yr.	1,530 Sq.Mi.	22,550	69,544	193,091	100,118	29,689	21,799	21,404	458,695
2. Average monthly discharge of Little Wind River at gaging station near Arapahoe, Wyoming, above confluence with Popo Agie River.[1]										
Sec. 25, T. 1 S., R. 5 E.	1906-1918 Intermittent 11 yr.	716 Sq.Mi.	6,781	20,856	76,600	45,482	13,119	8,622	7,858	179,536
3. Computed average monthly discharge of Popo Agie River above confluence with Little Wind River near Arapahoe, Wyoming. (1 minus 2).										
Sec. 25, T. 1 S., R. 5 E.	1906-1918 Intermittent 11 yr.	814 Sq.Mi.	15,769	48,688	116,491	54,636	16,570	12,177	13,546	279,159
4. Average monthly discharge of Little Popo Agie River at Hudson, Wyoming, near and above confluence with Big Popo Agie River.[1]										
5/8 mi. S. W. of Hudson at Highway bridge	1907-1917 1938 Intermittent 8 yr.	346 Sq.Mi.	5,210	13,574	27,430	12,040	[illegible]	3,479	4,077	70,037
5. Average monthly discharge of Little Popo Agie River at Hudson, Wyoming, near and above confluence with Big Popo Agie River.[1]										
5/8 mi. S. W. of Hudson at Highway bridge	1 year 1938	346 Sq.Mi.			14,380	4,170	966	2,650		22,166

TaLDS,

Location	Period of Record	Dr ember	October	Total for Period Shown
1. Average monthly discharge of e with Little Wind River.[1]				
Sec. 23, T. 1 S., R. 3 E.	1906-1918 Intermittent 11 yr.	14,799 S	21,400	458,695
2. Average monthly discharge of nce with Popo Agie River.[1]				
Sec. 23, T. 1 S., R. 3 E.	1906-1918 Intermittent 11 yr.	8,622 S	7,852	179,536
3. Computed average monthly dis apahoe, Wyoming. (1 minus 2).				
Sec. 23, T. 1 S., R. 3 E.	1906-1918 Intermittent 11 yr.	3,177 S	13,548	279,159
4. Average monthly discharge of h Big Popo Agie River.[1]				
3/8 mi. S. W. of Hudson at Highway bridge	1907-1917 1938 Intermittent 8 yr.	3,479 S	4,075	70,037
5. Average monthly discharge of h Big Popo Agie River.[1]				
3/8 mi. S. W. of Hudson at Highway bridge	1 year 1938	2,650 S		22,166

Table 1.--AVERAGE MONTHLY DISCHARGE, DIVERSIONS, RECONSTRUCTED FLOW, AND YIELDS, ALL IN ACRE-FEET, AT STATIONS IN THE POPO AGIE DRAINAGE BASIN.
(continued)

Location	Period of Record	Drainage Area	April	May	June	July	August	September	October	Total for Period Shown
6. Average monthly discharge of Middle Fork Popo Agie River near Lander, Wyoming, above all diversions except from Roaring Fork, tributary of Middle Fork.[1]										
Sec. 24, T. 32 N., R. 101 W. After 1921 Sec. 17, T. 32 N., R. 100 W.	1911-1913 1918-1925 Intermittent 7 yr.	84 Sq.Mi.	1,617	15,882	38,850	14,013	4,415	2,505	3,113	80,397
7. Average monthly discharge of North Fork of Popo Agie River near Lander, Wyoming.[1]										
Sec. 17, T. 2 S., R. 1 E.	1 yr. June-Sept. 1938	21.9[2] Sq.Mi.			24,590	9,690	3,110	9,220		46,610
8. Net Irrigation Requirements shown in Technical Bulletin 36, U.S.D.A. - 1.7 acre-feet per acre.										
Percentage of Seasonal Requirement				6	32	41	18	2	1	100
Requirement - acre-feet per acre including 30 per cent conveyance loss[3]				.146	.778	.996	.437	.049	.024	2.43
9. Appropriations from Middle Fork Popo Agie River below station at Lander, Wyoming, for irrigation of 17,965 acres.[3]										
				2,623	13,977	8,947	-	-	-	25,547
10. Appropriations from Little Popo Agie River for irrigation of 4,495 acres.[3]										
				656	3,497	2,239	-	-	-	6,392
11. Appropriations from North Fork of Popo Agie River for irrigation of 8,720 acres.[3]										
				1,273	6,784	4,343	-	-	-	12,400

TaLDS,

Location	Period of Record	Dr ember	October	Total for Period Shown
1. Average monthly discharge ofe with Little Wind River.[1]				
Sec. 23, T. 1 S., R. 3 E.	1906-1918 Intermittent 11 yr.	11,799 S	21,400	458,695
2. Average monthly discharge ofence with Popo Agie River.[1]				
Sec. 23, T. 1 S., R. 3 E.	1906-1918 Intermittent 11 yr.	8,622 S	7,852	179,536
3. Computed average monthly disapahce, Wyoming. (1 minus 2).				
Sec. 23, T. 1 S., R. 3 E.	1906-1918 Intermittent 11 yr.	3,177 S	13,548	279,159
4. Average monthly discharge ofh Big Popo Agie River.[1]				
3/8 mi. S. W. of Hudson at Highway bridge	1907-1917 1938 Intermittent 8 yr.	3,479 S	4,075	70,037
5. Average monthly discharge ofh Big Popo Agie River.[1]				
3/8 mi. S. W. of Hudson at Highway bridge	1 year 1938	2,650 S		22,166

Table 1.--AVERAGE MONTHLY DISCHARGE, DIVERSIONS, RECONSTRUCTED FLOW, AND YIELDS, ALL IN ACRE-FEET, AT STATIONS IN THE POPO AGIE DRAINAGE BASIN.
(continued)

Location	Period of Record	Drainage Area	April	May	June	July	August	September	October	Total for Period Shown
12. Appropriations from Roaring Fork above gaging station at Lander, Wyoming, to supply Enterprise Ditch, to irrigate 3,870 acres.[5]										
			-	1,581	1,530	765	-	-	-	3,876
13. Reconstructed Run-off of Middle Fork of Popo Agie River above the gaging station near Lander, Wyoming. (Sum of 6 and 12).										
		84 Sq.Mi.	1,617	17,463	40,380	14,780	4,415	2,505	3,113	84,273
14. Yield in acre-feet per square mile above gaging station on Middle Fork of Popo Agie River near Lander, Wyoming.										
		84 Sq.Mi.	19.2	208	481	176	52.6	29.8	37.1	
		Total run-off, April to October inclusive, of Middle Fork of Popo Agie River Drainage above gaging station near Lander in acre-feet per square mile								1,004
15. Run-off of Roaring Fork above Point of Diversion of Enterprise Ditch. (Yield per square mile from 14).										
		15 Sq.Mi.[6]	288	3,120	7,215	2,640	789	447	556	15,055
16. Irrigation Requirements of Lands under Enterprise Ditch, or 3,870 acres. (Based on 1.7 acre-feet per acre plus 30 per cent ditch loss as shown in 8).										
			-	565	3,011	3,855	1,691	190	93	9,405
17. Water available for storage in Frye Lake. (Run-off 15 minus Irrigation Requirements 16 of land under Enterprise Ditch to July 15).										
			288	2,555	4,204	-	-	-	-	
		Water Available for Storage in Frye Lake Reservoir in acre-feet[4]								7,047

Ta LDS,

Location	Period of Record	Dr ember	October	Total for Period Shown
1. Average monthly discharge of e with Little Wind River.[1]				
Sec. 23, T. 1 S., R. 3 E.	1906-1918 Intermittent 11 yr.	11,799 S	21,400	458,695
2. Average monthly discharge of ence with Popo Agie River.[1]				
Sec. 23, T. 1 S., R. 3 E.	1906-1918 Intermittent 11 yr.	8,622 S	7,852	179,536
3. Computed average monthly dis apahoe, Wyoming. (1 minus 2).				
Sec. 23, T. 1 S., R. 3 E.	1906-1918 Intermittent 11 yr.	3,177 S	13,548	279,159
4. Average monthly discharge of h Big Popo Agie River.[1]				
3/8 mi. S. W. of Hudson at Highway bridge	1907-1917 1938 Intermittent 8 yr.	3,479 S	4,075	70,037
5. Average monthly discharge of h Big Popo Agie River.[1]				
3/8 mi. S. W. of Hudson at Highway bridge	1 year 1938	2,650 S		22,166

Table 1.--AVERAGE MONTHLY DISCHARGE, DIVERSIONS, RECONSTRUCTED FLOW, AND YIELDS, ALL IN ACRE-FEET, AT STATIONS IN THE POPO AGIE DRAINAGE BASIN.
(concluded)

Location	Period of Record	Drainage Area	April	May	June	July	August	September	October	Total for Period Shown
18. Run-off from drainage area above Christina Lake. (Yield per square mile from 14).										
		6 Sq.Mi.	115	1,248	2,886	1,056	316	179	223	6,023
		Water available for storage in Christina Lake Reservoir in acre-feet.[7]								4,249
19. Run-off from drainage area above Shoshone Lake. (Yield per square mile from 14).										
		11 Sq.Mi.	211	2,288	5,291	1,936	579	328	408	11,041
		Water available for storage in Shoshone Lake Reservoir in acre-feet.[7]								7,790
20. Reconstructed run-off of Little Popo Agie River above gaging station at Hudson, Wyoming. (Sum of 4 and 10).										
			5,210	14,230	30,907	15,079	3,449	3,479	4,075	76,429

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1 Gaging station records obtained from U.S.G.S. Water Supply Papers.

2 Measured on Forest Service Map.

3 Appropriations in Amount of Adjudicated Water Rights and Permits plus 30 per cent conveyence loss. Net requirement - 1.7 acre-feet per acre per season, monthly use as follows: May, 6%; June, 32%; July, 41%; August, 18%; September, 2%; October, 1%; in accordance with requirements stated in Technical Bulletin 36, U.S.D.A. Based on all requirements being met up to July 15.

4 Does not include Excess of Run-off over Requirements during months of September and October, which would not be available until after the need for storage had passed. Water will be stored during April, May, and June. There is a deficiency during July and August.

5 Based on diversion equal to 25.5 cubic feet per second capacity of supply ditch to Reservoir, as shown in State Engineer's office (May 1 to July 15 inclusive).

Water Rights

There are adjudicated water rights and permits totaling 714.64 cubic feet per second[1] for the irrigation of 48,659.5 acres of land from the three forks of the Popo Agie River and their tributaries. These water rights, most of which are adjudicated, date back to 1870. The primary or original appropriations from the various streams are as follows:

Stream	Cubic Feet per Second	Acres
North Fork of Popo Agie	151.67	8,717.57
Tributaries of North Fork Popo Agie	1.45	102.00
Big or Middle Fork Popo Agie	227.54	15,303.17
Tributaries of Middle Fork Popo Agie	255.34	17,965.40
Little Popo Agie	66.26	4,494.86
Tributaries of Little Popo Agie	52.38	2,076.50

It is believed, from conversations with local engineers and others, that all lands covered by these appropriations are not actually under irrigation. In addition to the above, there are the following Mechanical Rights:

Big or Middle Popo Agie	Aug. 10, 1888	40.70	Cu.Ft.per Sec.[2]
	Jan. 26, 1910	40.00	"[2]
	Mar. 3, 1919	20.00	"[3]
North Fork Popo Agie	Fall 1879	25.00	"[2]

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[1] Records of State Engineer's office, Cheyenne, Wyoming, June 1930.

[2] Not in use.

[3] Headgate above all diversions except Enterprise ditch from Roaring Fork.

Power rights will not interfere with the diversion of water for irrigation use, as the water reverts to the stream.

The following Reservoir Permits have been approved by the State Engineer and are in good standing:

Name of Reservoir	Use of Water	Storage in Acre-Feet	Source of Supply
Louis Lake	Irr.& Power	8,015.7 A.F.	Little Popo Agie
Louis Lake	Power	8,015.7 A.F.	Little Popo Agie and Louis Creek
Enterprise	Irr., Stk., Dom.	870.0 A.F.	Roaring Fork and Townsend Creeks
Worthing Meadow	Irrigation	467.5 A.F.	Roaring Fork
Christina	Irr., Stk., Dom.	2,452.25 A.F.	Little Popo Agie

There are included appropriations from the Middle Fork of 2.00 cubic feet per second and 2.40 cubic feet per second for municipal use in the town of Lander, with priority dates of February 25, 1905, and October 16, 1920. There is also a permit dated January 27, 1916, for the use of 127.4 cubic feet per second[1] from the Little Popo Agie for domestic purposes.

In addition to the foregoing appropriations, there are water rights from the Middle Fork and its tributaries for a secondary or supplemental water supply to irrigate 1,729.18 acres;[2] supplementary

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[1] Permit 13,232 - May 1, 1915 - 27.4 cu. ft. per second for power purposes. Enlargement Permit 3,575 - Jan. 27, 1916 - for 100 cu. ft. per second. Notice of failure to complete mailed to applicant. Plant apparently not constructed.

[2] 1,590 acres under Enterprise ditch.

rights from tributaries of the Little Popo Agie for 1,858.15 acres; and similar rights from the North Fork and its tributaries covering 543.19 acres. These appropriations, except lands under the Enterprise ditch (Priority September 27, 1902), have priority dates of 1915 and later. The lands in the area irrigated by these supplemental supplies are included since they have original appropriations. There are 250.39 acres which are irrigated under an original appropriation through the Ray ditch, from the South Fork of the Little Wind River, which are supplemented from the North Fork, but are not included in the tabulation. There is also an old right to use the waters of Christina and Gustave Lakes for mining purposes, but this has not been used for some time and it is reported by the water commissioner that there will be no objection to its cancellation. It would be advisable to have this cancellation effected before construction is undertaken at Christina Lake.

Irrigation Requirements

The seasonal net requirement for this section of Wyoming is 1.7 acre-feet per acre, distributed monthly by percentage of total as follows:[1]

	May	June	July	August	Sept.	Oct.	Season
Percentage	6	32	41	18	2	1	100
Acre-Feet	.10	.54	.70	.31	.03	.02	1.70

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[1] "Irrigation Requirements of the Arid and Semi-arid Lands of the Missouri and Arkansas River Basins," U.S.D.A. Technical Bulletin No. 36, March 8, 1928.

Under Wyoming law, an appropriation of 1 cubic foot per second may be made for each 70 acres of land to be irrigated.[1] Information from several sources, supported by windshield surveys, indicates that about 75 per cent of the lands covered by water rights are actually irrigated. This would indicate a lower duty of water and a higher seasonal requirement than permitted under the State Law.

On the basis of 1.70 net acre-feet per acre per season, distributed as previously stated, with estimated conveyance loss, from the outlet of the reservoir to the point of application plus evaporation and seepage, of 50 per cent,[2] the following amounts of water in acre-feet would be required to irrigate one acre:

May	June	July	Aug.	Sept.	Oct.	Total for Season
0.204	1.088	1.394	0.612	0.068	0.034	3.40

Present Irrigation Practice

At present, the use of water for irrigation purposes ordinarily starts about the middle of May and continues until fall, subject to

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[1] Mr. B. F. Cochrane, District Water Commissioner, Water Division 3, Wyoming, says, however, that from actual experience on his own ranch, located about 5 miles southeast of Lander, this amount is not sufficient. He estimates that, in order to irrigate land in this vicinity adequately, about 1 cubic foot per second for each 45 acres of irrigated land, or a continuous flow for a period of 60 days (2.75 acre-feet per season), is required.

[2] Estimate of Water Utilization Personnel, confirmed verbally by Ralph Parshall, Senior Agricultural Engineer, Bureau of Agricultural Engineering.

the limitation of the available water supply. While there is no definite information available, it is very probable that an excess of water, for irrigation, is being used during the period of high run-off. Continuation of this practice will result in an increased acreage of seep and alkali land. More adequate storage should result in a more beneficial use of irrigation water, in that the application of water can be more nearly adjusted to the seasonable requirements.

IV

EXISTING WATER FACILITIES

The principal existing facilities in the area are three small reservoirs and distribution systems supplying irrigation water to three irrigation districts.[1] The storage reservoirs, all located within Washakie National Forest, are: Frye Lake, Christina Lake, and Shoshone Lake, which serve the Enterprise Public Irrigation District, the Little Popo Agie Irrigation District, and the North Fork of Popo Agie Public Irrigation District, respectively.

Frye Lake

Frye Lake is an artificial lake located at an elevation of 8,500 feet on Townsend Creek, a tributary of Sawmill Creek, which is a tributary of the Middle Fork of the Popo Agie River. The lake occupies parts of Sections 26, 27, 34, and 35 in T. 32 N., R. 101 W. The watershed above the reservoir has an area of approximately 20 square miles.[2] The lake was formed by the construction of an earth-fill dam, under Reservoir Permit No, 4,555 R, approved by the State Engineer, dated August 30, 1953, to store 870 acre-feet with a maximum

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[1] See Map 5 in Appendix.

[2] Area figured from Forest Service Map of Washakie National Forest.

water depth of 13 feet.[1] The source of the water supply is Roaring Fork and Townsend Creek, both tributaries of the Middle Fork of the Popo Agie River. The diversion works from Roaring Fork are located in the SE$\frac{1}{4}$ NE$\frac{1}{4}$, Sec. 33, T. 32 N., R. 101 W. The dam was not completed. It is estimated that the present capacity of the reservoir is approximately 400 acre-feet,[2] with 5 feet of freeboard.

Water is released from the reservoir through a wooden flume and flows down Townsend Creek to Sawmill Creek, from which it is diverted into the Enterprise Ditch.

Christina Lake

Christina Lake is near the head of the Little Popo Agie River, near the Continental Divide, at an elevation of about 10,500 feet. It is located in Sections 7 and 8, T. 30 N., R. 101 W. The watershed has an area of about 6 square miles.[3] Reservoir Permit No. 4,623 R, dated July 20, 1935, was approved by the State Engineer for the storage of 2,452.25 acre-feet with a maximum water depth of 10 feet.[1] The existing dam at Christina Lake was built about 1890 to supply water for a hydraulic mining project. It has a territorial permit dated September 1888.[4] The project was abandoned after a few

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[1] Records of State Engineer's office, Cheyenne, Wyoming, June 1939.

[2] Capacity figures not available. Estimated, by County Surveyor, at 400 acre-feet.

[3] Area figures from Forest Service Map of Washakie National Forest.

[4] As per decree of Court of the Third Judicial District, dated June 6, 1890, in the matter of the application for an adjudication of the priorities of rights to use water for beneficial purposes, in Water District No. 8 on Rock Creek, a tributary of Sweetwater River in the County of Fremont, State of Wyoming, Tabulation of Water Rights in Water Division No. 3, p. 180.

years of operation and has not been used for mining purposes since. During a period of water shortage for irrigation, some of the settlers, because the outlet was clogged, blasted out a section of the dam[1] to release some of the water, with the result that there is a considerable hole in the center of the dam. At the present time, the lake stores about 1,100 acre-feet of water.[2] Waters from the lake are released into Little Popo Agie River, from which they are diverted by the ditches which serve the Little Popo Agie Irrigation Ditch. The Big Corral Ditch diverts from the Middle Fork of the Popo Agie River above its confluence with the Little Popo Agie River. Listed below are the ditches and approximate acreage served by each.[3]

Name of Ditch	Acres	Headgate Location
Shedd Ditch	568	SW¼SE¼ Sec. 23, T. 33 N., R. 99 W.
Rogers and Gregg	695	SW¼NE¼ Sec. 7, T. 33 N., R. 98 W.
Rogers and Gregg No. 2	692.3	NW¼SW¼ Sec. 5, T. 33 N., R. 98 W.
Lyons and Extension	922.76	NW¼NW¼ Sec. 24, T. 33 N., R. 99 W.
Millard Ditch	819.2	NW¼SE¼ Sec. 26, T. 33 N., R. 99 W.
Big Corral Ditch	762.3	SW¼ Sec. 20, T. 34 N., R. 98 W.
Total	4,459.56	

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[1] Reported by B. F. Cochrane, Water Commissioner.

[2] Estimated from information supplied by Soil Conservation Service Project Engineer, Lander, Wyoming.

[3] Records of State Engineer's office, Cheyenne, Wyoming, June 1939.

Shoshone Lake

Shoshone Lake is located on Shoshone Creek, a tributary of the North Fork of the Popo Agie River, in Sections 4 and 5, T. 32 N., and Sections 34 and 35, T. 33 N., all in R. 102 W., at an elevation of about 10,000 feet. Shoshone Creek runs through the lake about 4 miles above its junction with the North Fork. The Creek has a drainage area of about 11 square miles above the lake. The present dam, built in 1934 largely with funds furnished by the Federal Government under the drought relief program, is a log crib filled with earth and provided with wooden gate and wasteway in the center of the dam. Water is released from the reservoir into Shoshone Creek. The reservoir stores about 950 acre-feet of water.[1] The water, which is diverted from the North Fork of the Popo Agie River, is distributed to the land through 32 separate ditches.

Stock and Domestic Water

There has been some stock water development in the area in the form of storage ponds and spring development. In general, the supply of water for stock purposes seems to be adequate. Due to the presence of salts and minerals in some subsurface waters, people living near flowing streams have been using surface water for domestic purposes. Whenever the creeks reach flood stage, the surface

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[1] Estimated from information furnished by Soil Conservation Service Project Engineer, Lander, Wyoming.

water is not fit for human consumption, and numerous operators in the vicinity of Lander haul water from town. In general, the domestic water shortage can be alleviated or overcome by proper well construction.

Ditches

All of the ditches conveying water to the lands that are to be benefited by supplemental water from storage are operating under permits approved by the State or have adjudicated rights.

Irrigation Districts

The Enterprise Public Irrigation District is a regularly formed public irrigation district under the laws of the State of Wyoming. This district has an area of 6,700 acres. The Enterprise Ditch, which serves this district, supplies 3,878 acres of lands covered by permits and adjudicated rights, of which 3,637 acres are within the district. Water stored in Frye Lake will supplement the direct flow appropriations within the boundaries of the district.

The North Fork of Popo Agie Public Irrigation District is a regularly formed public irrigation district under the laws of the State of Wyoming. This district has an area of 11,880 acres. The numerous ditches serving the district supply 8,720 acres of lands covered by permits and adjudicated rights of which 7,919 acres lie

within the district. Water stored in Shoshone Lake will supplement the direct flow appropriations within the boundaries of the district.

It appears that an attempt was made to form the Little Popo Agie Irrigation District under the Wyoming Revised Statutes, 1931, Chapter 121, Article 7, Irrigation Districts. The State Engineer, in a letter to the District Water Utilization Supervisor, Bureau of Agricultural Economics, stated as follows: "The Little Popo Agie Irrigation District was formed by Court action under the old irrigation district law. According to our best information, the preliminary engineering report on this district was approved by the State Engineer on July 20, 1935, but we do not have instructions as to when the district was created by Court action." The County Clerk of Fremont County, Wyoming, under the date of June 13, 1939, wrote to the District Water Utilization Supervisor, Bureau of Agricultural Economics as follows: "As to the Little Popo Agie Irrigation District, we have no record, and the records of the Clerk of the Court show it to be in a rather unsettled state on account of objections to the formation of a district by a number of the ranchers that would come within the said district."

A map is on file with the State Engineer showing the appropriations for irrigation in the Little Popo Agie Valley but does not delineate the boundaries of the irrigation district. A map prepared by a private engineer, supposedly to accompany a petition

for the formation of a public irrigation district under the Provisions of Chapter 123, Session Laws of Wyoming, 1937, shows the boundaries of the proposed district. There is no evidence to show that this map has been filed. The area included within the boundaries indicated on this map is 5,900 acres. The ditches shown on the map serve 4,459 acres of lands covered by permits and adjudicated rights of which 3,336 acres lie within the proposed district. Water stored in Christina Lake will supplement direct flow appropriations within the boundaries of the proposed district.

Chapter 123 of the Session Laws of Wyoming, 1937, provides that Public Irrigation Districts may be organized " *** to provide for the creation, incorporation, conduct and operation of public irrigation districts *** : to provide for and restrict the liability of such districts for the payment of indebtedness or other obligation solely to (1) revenues, income, receipts and profits of such districts derived from the operation of the works, systems, plants and properties owned or operated by such districts, and (2) to the issuance or sale of warrants, notes, revenue bonds or other evidences of indebtedness payable solely from such revenues, income, receipts and profits; to provide that such districts shall have no powers of taxation; to prohibit the payment of indebtedness of such districts by or from taxation; to authorize the making of water appropriations by such districts; to provide, among other

powers of such districts, for the acquisition, construction and operation by such districts of irrigation and storage works, power plants, transmission lines, service and distribution of water within or beyond the boundaries of such districts; to authorize the charge and collection by such districts of reasonable and non-discriminatory prices, costs, rates, rents or fees for water, power and other commodities, facilities and services sold, furnished or supplied by such districts; to provide for the creation of certain funds by such districts in connection with operations under this Act; *** "

V

ECONOMIC CONDITIONS IN THE AREA

Fiscal Conditions

Financially, Fremont County is in good condition. For the last tax year (1938), approximately 80 per cent of the taxes have been collected,[1] and over the past 10-year period tax collections have averaged between 85 to 90 per cent.[2]

The county takes a tax deed to property after it has become delinquent for 4 years. The county commissioners then dispose of this land as best they can. At present, the county holds tax title to 55,124 acres, which is valued at $529,429. The county also holds tax title to a considerable amount of taxable property of the town of Hudson. This is due, probably to the fact that most of the mines have closed entirely or serve only local demands. These are known locally as "wagon mines."

Fremont County has no bonded indebtedness. Some of the school districts, however, are bonded. The bonded indebtedness

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[1] Taxes not paid by August 1 will be advertised for tax sale. Second installment of taxes becomes delinquent May 10.

[2] Statements of County Treasurer, Fremont County, Wyoming.

of school districts, either partly or wholly within the three irrigation districts, is shown in the following tabulation:

District	Issue	Date Issue	Rate of Int.	Date Due	Balance Due
1	$65,000	5/1/36	3½%	Serial	$61,000
2	3,200	8/25/20	6	8/25/45	2,000
8	1,500	7/1/32	4½	7/1/42	1,500
51	4,000	1/1/21	6	1/1/46	2,000

The records of the county treasurer reveal no outstanding indebtedness for the irrigation districts.

Loans and Grants

As of June 1, 1939, Farm Security Administration had loans totaling $8,856 for the three irrigation districts. There were no grant cases.[1]

It appears that most of the operators are not heavily indebted. However, in considering their financial condition, the fact that most of the ranches are under-stock from 25 to 50 per cent of their normal capacity is significant.[2]

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[1] Data furnished by Farm Security Administration office at Lander, Wyoming.

[2] "Understocked" estimates furnished by Farm Security Administration representatives at Lander, Wyoming.

Land Values

The assessed land values have varied but little in the past 10 years.[1]

Lands within the three irrigation districts are subject to levies varying from 17 to 28 mills. The tax per acre on the various classes of land is shown in the following tabulation:

Class of Land	Assessed Value[2]	Tax per acre based on 17 Mills	23 Mills	28 Mills
Grazing	$ 1.94	.03	.04	.05
Irrigated cultivated (1st class)	38.66	.66	.89	1.08
Irrigated cultivated (2nd class)	21.10	.36	.49	.59
Uncultivated land with water right	14.67	.25	.34	.41
Irrigated pasture	11.64	.20	.27	.33
Dry farm	5.99	.10	.14	.17

In recommending water improvements commensurate with land values, it must be remembered that the above levies per acre are a legitimate cost which the land must support. The tax per acre on irrigated land is relatively high in view of the fact that the bulk of the land is devoted to the production of alfalfa or feed crops.

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[1] Statement of County Treasurer, Fremont County, Wyoming.

[2] 1938 Assessed Land Values, Fremont County, Wyoming. Values obtained from County Assessor, Fremont County, Wyoming. These values are representativ of the area with which this report is concerned according to the County Treasurer of Fremont County, Wyoming.

Ownership and Tenure

The operators within the three districts operate a total of 28,713 acres, of which 24,480 acres are located within the boundaries of the three irrigation districts. Eighty-eight per cent of the land operated is owned by individuals residing in the area or immediately adjacent to it, while only 1 per cent is owned by individuals who do not reside in or near the area. Corporations own 11 per cent of the area operated.

Of the 97 farm units, 59 per cent are owner-operated. Part owners, or owners additional, operate 9 per cent of the units; tenants operate 24 per cent; managers, 1 per cent; and unknown, 7 per cent.

With an ownership and tenure pattern as indicated above, a program designed for proper land use and conservation of water resources should encounter no difficulties as both owners and operators are cognizant of the basic problems within the area. Supplemental storage is needed for late summer irrigation to bring about maximum utilization of land resources. The people within the area realize this, and full cooperation may be expected.

Types of Farming[1]

Stock farms and ranches, general, and crop specialty farms are the most important types of farming to be found in this area, as is revealed by the following table:[2]

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[1] This section of the report is based primarily on data contained in the following publication: Hunter, Byron; Pearson, H.W.; and Vass, A.F. - "Type of Farming and Ranching Areas in Wyoming," - Experiment Station, Laramie, Wyoming, Bulletin 228, July 1938.

[2] This distribution is for the area of which the three irrigation districts are a part.

Type of farm	Per cent
Stock farms and ranches	24
General	21
Crop specialty	20
Cash grain	8
Self-sufficing	8
Unclassified	6
Part-time	4
Dairy	4
Poultry	2
Truck	1
Abnormal	2
Total	100

Source: 1929 Census

The above classification was made in accordance with definitions as used in the Census, with but one exception. To meet Wyoming conditions best, "animal specialty" and "stock ranch" farms have been combined to form one group, or type, "stock farms and ranches." Some of the farms, in irrigated districts, classified as "animal specialty" are simply farms on which lambs or cattle were fed during the fall and winter for 60 days or more, the livestock being purchased as feeders at the beginning of the feeding period.

Of the "crop specialty" farms, hay production is the most important. In the Little Popo Agie Irrigation District, some sugar beets are raised, but the acreage devoted to this crop is very limited, and a material increase in acreage cannot be expected as marketing facilities are not satisfactory.

While only 4 per cent of the farms were classified as "dairy," it is generally agreed by people familiar with the area that dairying is increasing in importance and will probably continue to increase in the future. Two creameries are maintained—one at Lander and one at Riverton—thus affording dairy operators adequate markets for produce which is not consumed by the families.

Productive Capacity

Only a limited amount of data applying specifically to the productive capacity of the area is available. Detailed farm plans and investigations will probably reveal a wide variation from yields given below.

Average Yields[1]

Crop	Yields
Wheat	25 Bu.
Barley	40 Bu.
Oats	40 Bu.
Alfalfa	1-1½ T.
Sugar Beets	12-14 T.
Native Hay	1½ T.

The above yields do, however, represent what may be expected under existing conditions. With a late summer irrigation, which is

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[1] These yields apply specifically to the area under consideration, as furnished by the County Agent's and Farm Security Administration's offices at Lander, Wyoming.

to be supplied from the proposed reservoirs, it is felt that grain yields can be increased from 5 to 15 bushels per acre. An increase in alfalfa yields of at least 1/2 ton, and under especially favorable conditions a ton, may be expected. Native hay, which is mostly sub-irrigated, would not be affected.

As indicated in the section on "Land Use," alfalfa and feed crops comprise over 70 per cent of the acreage devoted to crops. These crops are to benefit from the storage of supplemental water.

Land Use[1]

Livestock production, which predominates in the area, consists primarily of range cattle and sheep, dairy and farm flocks. Practically all land not irrigated is used for grazing purposes. Irrigated lands, lying in the stream valleys and on lower benches, and on terraces and level areas to which water can be diverted, are used primarily for the production of crops closely related to the livestock industry, as is revealed by the tabulations which have been made for each of the districts involved. As revealed by these data, alfalfa and sweet clover made up 55 per cent of the total acreage devoted to crops; barley and oats, 20 per cent; wheat, 11 per cent; sugar beets, 3 per cent; and all other crops, 6 per

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[1] 1938 Agricultural Adjustment Administration data, Fremont County, Lander, Wyoming.

cent. Of the cropland 5 per cent was classed as idle. Practically all the hay and grain produced is consumed within the area.

A fairly complete land use picture of 1938 crop operations in the three irrigation districts was obtained from the Agricultural Adjustment Administration office at Lander, Wyoming. Since the districts are not adjacent and each district contemplates the construction of a reservoir for supplemental storage, the land use will be presented separately for each district.

In 1938, there were 25 operators in the Enterprise Irrigation District. Data on 20, or 80 per cent of the operators, is available and reveals that of a total of 8,412 acres operated, 1,845 acres, or 30 per cent, were devoted to crops. The acreage and percentage of land devoted to each specific crop is indicated in the following table:

Crop	Acres	Per cent
Wheat	146	8
Barley	137	7
Oats	273	15
Alfalfa	1,055	57
Sweet Clover	122	7
Idle	38	2
All other crops	74	4
Total	1,845	100

It readily can be seen that practically all of the cropland is used for the production of hay or supplemental feed crops. The

amount of idle land is negligible and does not indicate any serious problem. Within the operating units of the 20 operators, 5,090 acres or 61 per cent is classed as non-crop pasture.

The operators[1] in the Little Popo Agie Irrigation District operate a total of 6,810 acres of which 2,505 acres, or 37 per cent, are classed as cropland. Type of crops, acres devoted to each crop, and the respective percentages of cropland in each crop is presented for 91 per cent of the operators,[2] who have a total of 2,385 acres of cropland.

Crop	Acres	Per cent
Sugar beets	223	9
Wheat	319	13
Barley	132	5
Oats	290	12
Alfalfa	946	40
Sweet clover	228	10
Idle	185	8
All other crops	62	3
Total	2,385	100

It will be noted from the above summary that chief emphasis is placed on the production of hay and feed crops. Alfalfa, oats, barley, and sweet clover constituted 67 per cent of the acreage

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[1] For 1939 there will be only 22 operators as two of the present units will be combined to form one unit.

[2] The total cropland for each unit was obtained for the other two operators, but the use by type of crop was not available.

devoted to crops. The acreage devoted to sugar beets is relatively small, and it probably will not increase greatly in the future as marketing facilities are not too favorable, owing to the fact that the distance to a factory is such that operators must pay a transportation charge of 50 cents per ton.[1] The amount of idle land is not in excess of what may be expected for an area of this size. The non-crop pasture within the units of all the operators in this district totals 3,988 acres.

Data for the North Fork of Popo Agie Public Irrigation District is not as complete as the data for the other two districts. There appear to be 49 operators in this district. Crop data is available for 75 per cent of the operators. Such operators operate a total of 11,672 acres, of which 3,838 acres, or 33 per cent, are cropland. The land use for the 3,838 acres is shown in the following tabulation:

Crop	Acres	Per cent
Wheat	398	10
Barley	258	7
Oats	487	13
Alfalfa	1,625	42
Sweet clover	491	13
Idle	209	5
Other	370	10
Total	3,838	100

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[1] Hunter, Byron; Pearson, H. W.; and Vass, A.F. — "Type of Farming and Ranching Areas in Wyoming," - Experiment Station, Laramie, Wyoming, Bulletin 228, July 1938.

Alfalfa, sweet clover, and feed crops make up 75 per cent of the acreage devoted to the production of crops, while 5,452 acres within the operating units of all the operators are classed as non-crop pasture.

Size of Operating Units

There are 97 operating units which have all or part of their lands within the boundaries of the three irrigation districts.[1] Of these units 35 per cent are between 161 and 320 acres in size. The distribution of farms or ranches by size is shown in the following tabulation:

Size Distribution	Number	Per cent
80 acres or under	12	12
81 - 160	21	22
161 - 320	34	35
321 - 480	13	14
481 - 640	9	9
641 and over	8	8
Total	97	100

Some of the units falling in the "80 acres or under" class are not operating units in the true sense of the word, but are

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[1] The above number is not a fixed figure as the number will vary from year to year. The above figure is based mainly on 1938 Agricultural Adjustment Administration data.

really subsistence units. Working in mines, haying, and odd jobs furnish these operators with additional income.

While the size of the operating units appears to be small, stockmen in the area depend on National Forests, Taylor Grazing, and Indian Reservation land for summer grazing. In effect, then, operating units are actually larger than the foregoing summary would indicate. The foothills, meadows, and irrigated pastures furnish the spring and autumn grazing, while feed for wintering livestock is provided at the ranch headquarters within the area.

Grazing fees (for National Forests) for any one year are determined by the average price received per pound for lambs and beef cattle, exclusive of calves, the previous year in the 11 Western range states.[1] Grazing fees on the Washakie Forest range from 14 cents to 19 cents per head per month for cattle, and from 2½ to 6 cents per head per month for sheep. A comparison of these fees with what stockmen pay for using private land is difficult to make as there are too many factors which must be considered. In general, however, grazing fees are higher for private leases than for National Forest lands.

"For the purpose of contributing to the stability of the livestock industry and making the forage resources of the national

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[1] U. S. Forest Service -- "The Use Book," -- 1936. For a complete discussion of grazing fees, refer to Reg. G-10.

forests of the greatest value, the Forester shall provide for the recognition of preferences in the use of national forest ranges ***"[1]

Grazing preferences may be obtained by: (1) Prior use and occupancy of lands included within a national forest, and (2) local residence and ownership of commensurate ranch property dependent upon the range.[1] While operators may acquire a preference in the allocation of grazing privileges, no legal right will accrue to the use of national forest range. A preference merely entitles the holder to special consideration over other applicants. Operators who comply with Forest Service regulations and who are dependent on national forest lands can plan their operations on a long-time basis and thus tend to stabilize their operating units.

Because the three irrigation districts are not adjacent to one another and since each district contemplates the construction of a reservoir for storage of supplemental water, the number of operators and size distribution is presented separately for each district.

In the Enterprise Public Irrigation District, there are 25 operators who will benefit by the proposed reservoir at Frye Lake. These operators operate a total of 9,592 acres, of which 6,700 acres are within the boundaries of the irrigation district. Of this

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[1] U. S. Forest Service - "The Use Book," - 1936.

6,700 acres, approximately 2,700 acres[1] are irrigated and must stand the cost of supplemental storage. The units of these operators vary in size from 80 acres to 1,320 acres. The number and size distribution of such units are shown in the following table.

Table 2.—DISTRIBUTION OF FARMS AND RANCHES
ACCORDING TO SIZE
IN THE
ENTERPRISE PUBLIC IRRIGATION DISTRICT, FREMONT COUNTY, WYOMING.

Acres	Number	Per cent
80 Acres	1	4
81 - 160	5	20
161 - 320	8	32
321 - 480	5	20
481 - 640	3	12
641 and over	3	12
Total	25	100

Source: Assessor's records and 1938 Agricultural Adjustment Administration data, Fremont County, Wyoming.

In the Little Popo Agie Irrigation District, there are 23 operators who will benefit by the proposed reservoir at Christina

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[1] Seventy-five per cent of land covered by water rights.

Lake. These operators operate a total of 6,810 acres, of which 5,900 acres lie within the boundaries of the irrigation district. The irrigated acreage is estimated to be 2,500 acres,[1] which would have to bear the cost of the construction providing supplemental storage. The size distribution of the units of these operators is shown in the following table.

Table 3.--DISTRIBUTION OF FARMS AND RANCHES
ACCORDING TO SIZE
IN THE
LITTLE POPO AGIE IRRIGATION DISTRICT, FREMONT COUNTY, WYOMING.

Acres	Number	Per cent
80 acres and under	2[2]	9
81 - 160	7	30
161 - 320	8	35
321 - 480	4	18
481 - 640	1	4
641 and over	1	4
Total	23	100

Source: Assessor's records and 1938 Agricultural Adjustment Administration data, Fremont County, Wyoming.

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[1] Seventy-five per cent of acreage covered by water rights.

[2] One unit of 40 acres not operating.

Forty-nine operators in the North Fork of Popo Agie Public Irrigation District will benefit through the proposed reservoir at Shoshone Lake. The acreage operated by these 49 operators totals 12,311 acres,[1] of which 11,880 acres are within the district's boundaries and of which 5,940 acres[2] are irrigated. The size distribution of the units of these operators is shown in the following table.

Table 4.—DISTRIBUTION OF FARMS AND RANCHES
ACCORDING TO SIZE
IN THE
NORTH FORK OF POPO AGIE PUBLIC IRRIGATION DISTRICT, FREMONT COUNTY, WYOMING.

Acres	Number	Per cent
80 acres and under	9	18
81 - 160	9	18
161 - 320	18	36
321 - 480	4	9
481 - 640	5	10
641 and over	4	9
Total	49	100

Source: Assessor's records and 1938 Agricultural Adjustment Administration data, Fremont County, Wyoming.

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[1] 12,311 represents the acreage actually operated by 48 operators. The one unit of 12,960 acres is not included in the summaries made, as the bulk of this unit lies outside the area.

[2] Seventy-five per cent of acreage covered by water rights.

The farm units now operated in the area range in size from 80 acres and under to 1,320 acres.[1] Because irrigation water is inadequate during the season of greatest need, it is not now possible to obtain maximum production of hay, grain, and other crops produced. It is felt that with the construction of the three proposed reservoirs, production can be increased and a fuller utilization of land can be attained, thereby helping to stabilize the existing units and the economy of the area in general.

The benefits from additional supplemental water will be derived only by lands now irrigable. The irrigation of new lands is not anticipated under these constructions. As a result, the size of the present operating units cannot be materially affected. Most units are not limited so much as to size, but they are understocked anywhere from 25 to as high as 50 per cent.[2]

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[1] One unit of over 12,000 acres is mostly out of this area.

[2] Estimate of Farm Security Administration representative at Lander, Wyoming.

VI

RECOMMENDED LAND USE

From data that is available, and from opinions of people familiar with the area, the probable best land use is now being practiced, and the type of farm and ranch operations will not be greatly altered or changed by additional storage. As pointed out elsewhere in the report, stock farms and ranches are the dominant type of farms to be found within the area. The ratio existing between cropland, pasture, and range land will determine the type of a livestock set-up an operator will have.

In late years, dairying has increased in importance and will probably continue to do so. Adequate marketing facilities are available for dairy operators. Detailed farm plans will indicate whether an operating unit has sufficient feed base and pasture to place major emphasis on dairying.

Within the three districts, there are less than 300 acres devoted to the production of sugar beets. While sugar beets are a good cash crop, yield fairly well, and some of the soil is adapted to their production, a material increase in acreage probably will not take place because of unfavorable marketing facilities.

The suitability of a unit for sugar beet production will have to be considered individually.

To obtain maximum utilization of land resources, efficient size of unit is of great importance. The size of unit will vary with the type of unit and the quality of the land within the operating unit. The acreage of land required naturally increases as the quality of the land decreases. Where operators depend on grazing permits for summer range, an economic unit must leave a sufficient feed base to winter the livestock which is carried over.

Sufficient information is not available to recommend in this report the best land use for specific sections of the area. It will be, however, within the scope of an area plan to classify the land of the area as to quality and its use suitability. Similarly, lack of information does not permit the classification of grassland in accordance with carrying capacity. In all probability variations of sufficient importance between the carrying capacity of specific sections of the area do exist and, therefore, a detailed survey of the carrying capacity of the land is necessary prior to the determination of the maximum number of animal units which any one particular section of the area can reasonably support.

With a determination of the use suitability of land and the carrying capacity of the grassland in the area, it will then be possible to make recommendations which will probably cover such minor maladjustments in land use as may exist in the area.

VII

PROPOSED WATER FACILITY DEVELOPMENT

Reservoirs

The proposed developments consist of repair, restoration, and additional construction to the three storage reservoirs discussed under existing facilities, namely: Frye Lake, Christina Lake, and Shoshone Lake. These reservoirs would store additional water to be used for supplementary irrigation of lands under the Enterprise Public Irrigation District, the Little Popo Agie Irrigation District, the North Fork of Popo Agie Public Irrigation District, and such other lands in the area now under irrigation.

The three reservoirs should be enlarged to a storage capacity sufficient to furnish supplemental water for the irrigation of land in the respective irrigation districts which they serve and for such other land now under irrigation adjoining but outside of such districts. There are permits and adjudications for these lands under the ditches serving the districts but as they are located outside the boundaries of the irrigation districts they will not be benefited by these improvements if the use of

storage water is limited to lands within the defined boundaries of the districts. For the benefit of the greatest number, it appears advisable to provide the maximum storage commensurate with the available water supply, storage possibilities, economic limitations and public good.

Storage should be provided to supply supplemental irrigation water for one additional irrigation each season, amounting to about 4 inches of water net duty which will require about 8 acre-inches of storage per acre of land irrigated by direct diversion. Recently conducted field observations indicate a lesser acreage under actual irrigation than shown by adjudications and permits. Some lands have been retired from cultivation due to a seeped condition or other unfavorable conditions. Construction of these projects must comply with the requirements of the Forest Service and the State Engineer of Wyoming.

A study of the records in the State Engineer's office indicates that the legal requirements have, generally, been fulfilled in perfecting adjudicated water rights or permits for direct diversion from the streams through ditches affected by this development. Filings have been made for the original construction on Frye Lake and Christina Lake. Applications for enlargements of these should be filed with the State Engineer of Wyoming, and an application for permit to construct the Shoshone Reservoir should be filed with the State Engineer.

Ditches[1]

Field observations indicate that the distribution systems will require further studies to determine if the ditches should be repaired, improved, or enlarged to facilitate distribution and decreased conveyance losses. It appears that at some locations, where two or more ditches only a short distance apart, parallel each other, one larger ditch would better serve the purpose, lower maintenance costs, and decrease losses. There is at present a metal flume in the supply ditch from Roaring Fork to the Frye Lake Reservoir. The Irrigation District has planned to relocate the ditch so that this flume will be eliminated.

Measuring Devices

The importance of measuring devices is not to be underestimated. Lack of definite records of precipitation and run-off in the higher reaches of the drainage areas, actual diversions, and conveyance losses necessitated estimates of these factors from the best available information. It would be advisable to measure the water at several strategic points as an aid in the distribution of water. The installation of measuring devices and gaging stations would be advantageous for future planning and developments.

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[1] Files in the State Engineer's office at Cheyenne, Wyoming, show estimated capacities of 25.5 cubic feet per second for the supply ditches to Frye Lake Reservoir and 59.2 cubic feet per second for the ditch below the point of diversion from Sawmill Creek.

VIII

VALUE OF PROPOSED FACILITIES

The proposed facilities will provide supplemental water for late summer and early fall irrigations. At the present time, due to lack of sufficient storage, the peak flow of water is diverted to the land before it is actually needed. This has resulted in erosion and lowering of the productivity of the soil. Excessive use of irrigation water has also resulted in loss of plant food materials by solution and removal by leaching.

With the improvement of present storage facilities, peak flow water could be stored until such a time as it is needed. With a more intelligent seasonal application of water, increased yields should result. Increases of 5 to 15 bushels in grain yields and ½ to 1 ton in alfalfa yields can be expected. Crop specialty farms, producing alfalfa as a cash crop, could place a value on the increased yield in terms of the current market price. When fed to livestock the value of the increased yield is more difficult to determine. However, the value of alfalfa in this area is considered greater when marketed through livestock than when sold as a cash crop.

Additional storage will provide a more stable system of agriculture and insure a more efficient utilization of the land.

APPENDIX

MAPS

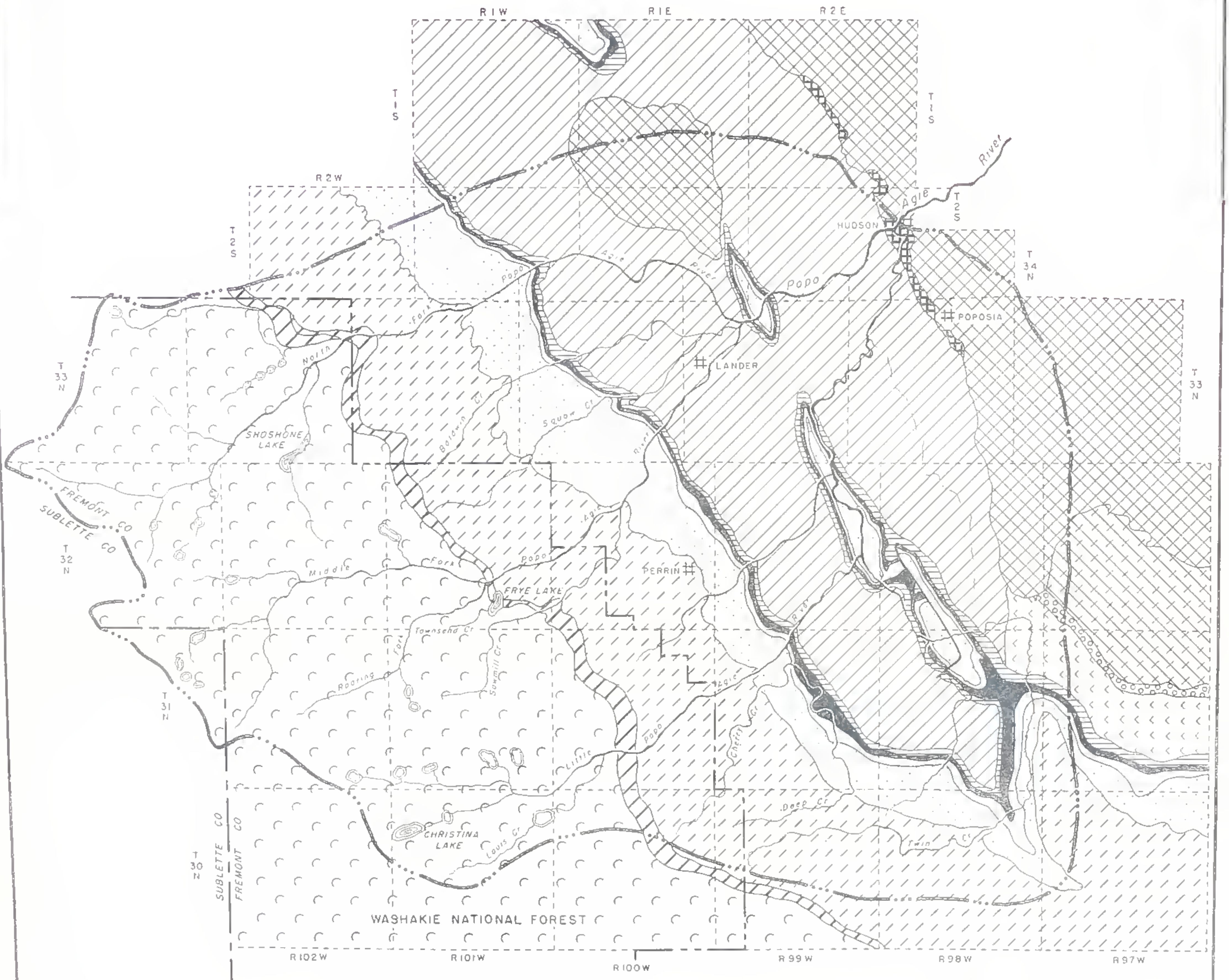
6 The 5 square miles of drainage area on Townsend Creek above the Reservoir have been omitted since information obtained from persons familiar with the area shows that, due to topography, there is little run-off from this source.

7 All run-off during April, May, and June, above the reservoirs at Christina Lake and Shoshone Lake, has been considered as potential storage since averages of stream gagings show sufficient water passing the stations at Lander and Hudson to satisfy adjudications and permits during these months when the run-off above Christina Lake has been deducted.

MAP I

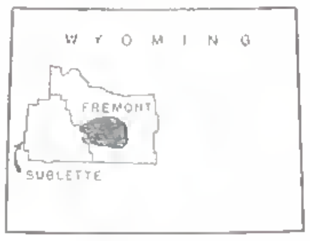
POPO AGIE DRAINAGE BASIN——WYOMING

GEOLOGY



LEGEND

- ▩ WIND RIVER FORMATION
- ⊞ MESAVERDE GROUP
- ▨ MANCOS SHALE
- ▩ STEELE SHALE
- ⁘ NIOBRARA FORMATION
- ‹ BENTON SHALE
- ▤ DAKOTA SANDSTONE
- ■ MORRISON FORMATION
- □ SUNDANCE FORMATION
- □ CHUGWATER FORMATION
- ▨ CARBONIFEROUS-UNDIVIDED
- ▨ DEVONIAN TO CAMBRIAN
- ◌ GRANITE, GNEISS, SCHIST, QUARTZITE
- WATERSHED BOUNDARY
- NATIONAL FOREST
- COUNTY LINE



U S DEPARTMENT OF AGRICULTURE BUREAU OF AGRICULTURAL ECONOMICS
DIVISION OF LAND ECONOMICS
WATER UTILIZATION SECTION
WATER FACILITIES PROGRAM

POPO AGIE DRAINAGE BASIN
FREMONT AND SUBLETTE COUNTIES
WYOMING

SCALE 1 0 1 2 3 4 5 MILES

REFERENCES U S G S GEOLOGIC MAP OF WYOMING —1925, U S G S BULLETIN No 452

COOPERATING AGENCIES

DATE AUG 1939
SHEET 1 OF 3

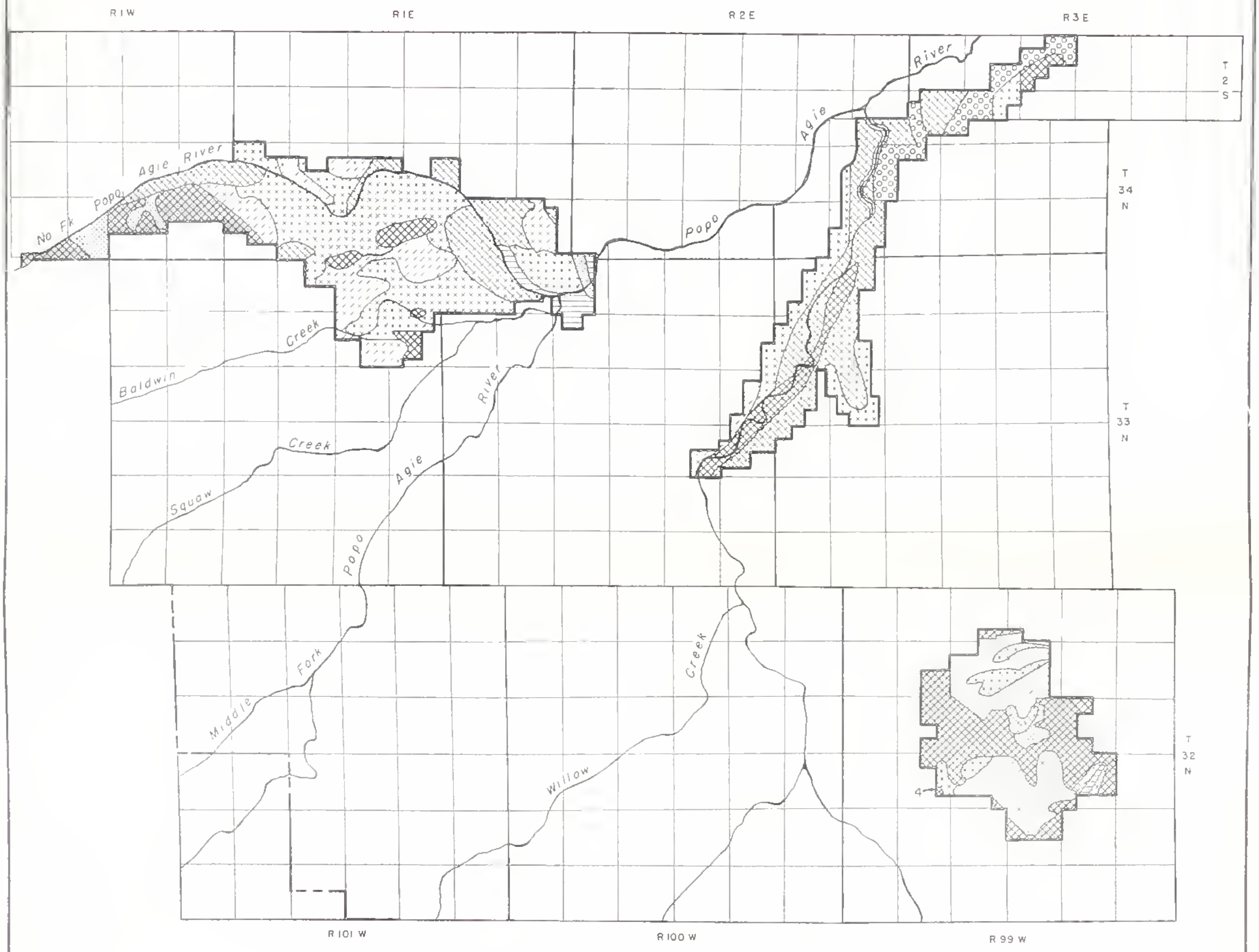
GEOLOGY

MAP 11-M-440 PREPARED BY THE CARTOGRAPHIC UNIT B A E

MAP 2

POPO AGIE DRAINAGE BASIN—WYOMING

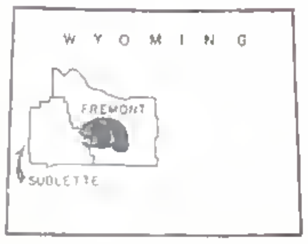
SOILS MAP



SOIL SERIES

E = ESTABLISHED NAME

T = FIELD NAME NOT YET PASSED UPON BY THE BUREAU CORRELATION COMMITTEE.



1 ▨ ETHETE T

2 ▨ SADDLE T

3 ▨ WIND RIVER E

5 ☐ CHUGWATER T

6 ▨ ARAPAHOE T

7 ▤ LAUREL AND HARLEM E

UNDIFERENTIATED

4 ▩ ROUGH AND BROKEN

8 ▩ WET ALKALI AREA

NOTE ADAPTED BY, ANDREW G. ALPHA, (ASSISTANT SOIL TECHNOLOGIST OF THE S C S) FROM, T J DUNNEWALDS "QUALITY OF SOIL, LANDER-WIND RIVER PROJECT, FREMONT COUNTY, WYOMING, 1934" AND A RECONNAISSANCE SURVEY BY SOIL CONSERVATION SERVICE AT LANDER, WYOMING, 1939

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DIVISION OF LAND ECONOMICS
WATER UTILIZATION SECTION
WATER FACILITIES PROGRAM

POPO AGIE DRAINAGE BASIN
FREMONT AND SUBLETTE COUNTIES
WYOMING

SCALE 1 0 1 2 3 MILES

REFERENCES SOILS DATA BY SOIL CONSERVATION SERVICE

COOPERATING AGENCIES

DATE AUG 1939
SHEET 2 OF 3

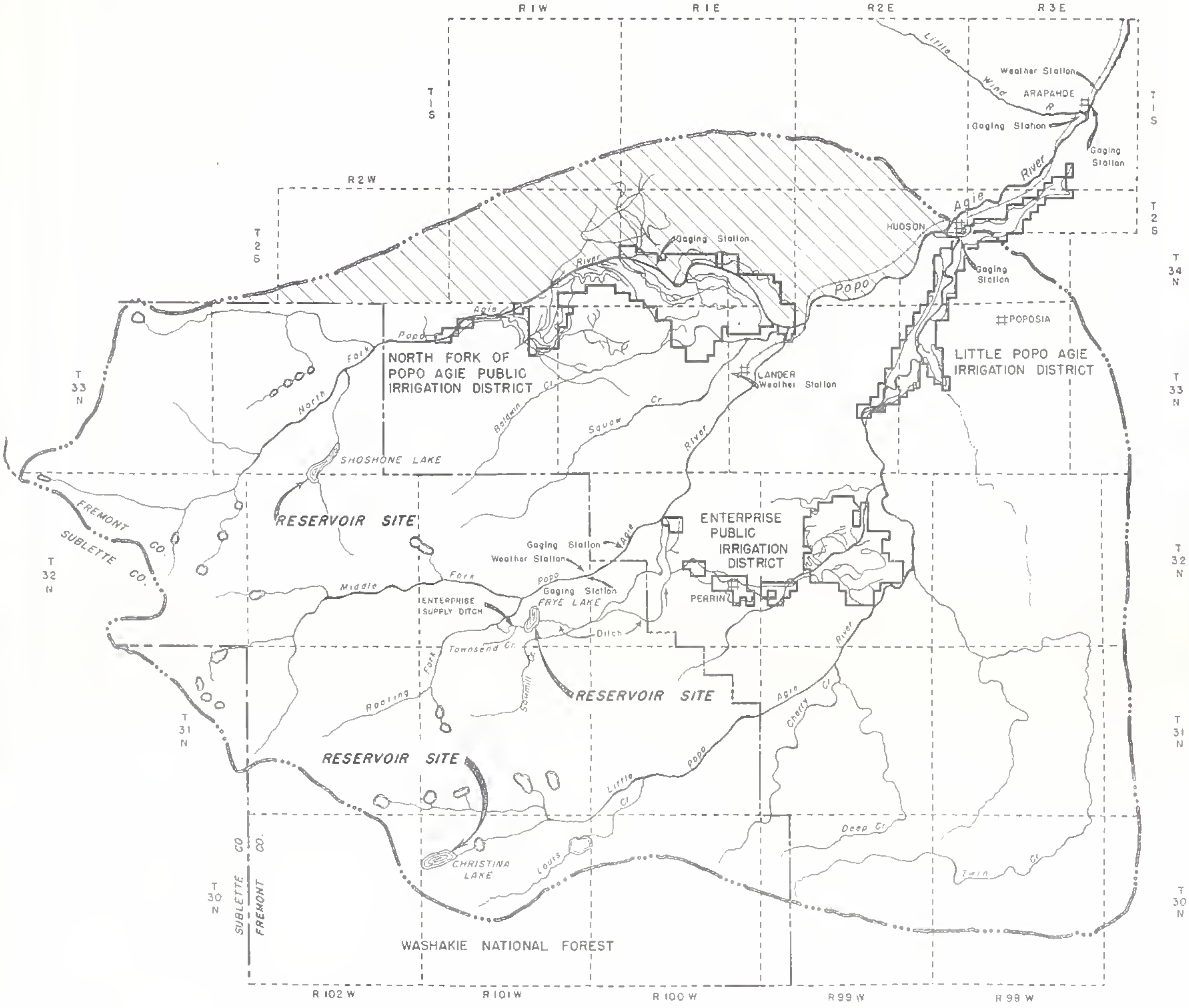
SOIL MAP

MAP 11-M-441 PREPARED BY THE CARTOGRAPHIC UNIT B A E

MAP 3

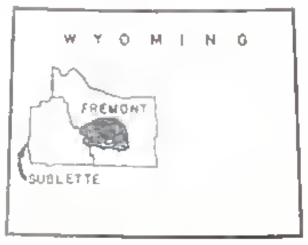
POPO AGIE DRAINAGE BASIN——WYOMING

IRRIGATION DISTRICTS, DITCHES AND RESERVOIR SITES



LEGEND

━•••━	WATERSHED BOUNDARY
━━	IRRIGATION DISTRICT
～～	DITCH
▨	INDIAN RESERVATION EXCLUDED FROM W F P AREA OF ACTIVITY
—·—·	NATIONAL FOREST
━ ━	COUNTY LINE



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WATER FACILITIES PROGRAM

POPO AGIE DRAINAGE BASIN
FREMONT AND SUBLETTE COUNTIES
WYOMING
SCALE 1 0 1 2 3 4 5 MILES

REFERENCES
COOPERATING AGENCIES

DATE AUG. 1939
SHEET 3 OF 3
IRRIGATION DISTRICTS
DITCHES AND RESERVOIR SITES

MAP 11-M-439 PREPARED BY THE CARTOGRAPHIC UNIT B. A. E.